

# Reactive Axillary Lymphadenopathy to COVID-19 Vaccination on $^{18}\text{F}$ -FDG PET/CT

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In this report, we present  $^{18}\text{F}$ -FDG PET/CT findings of reactive left axillary and supraclavicular hypermetabolic lymphadenopathy, as well as ipsilateral deltoid muscle injection site radiotracer uptake, related to recent coronavirus disease 2019 (COVID-19) vaccination in a patient with osteosarcoma. With the growing number of patients receiving COVID-19 vaccine, recognition of benign characteristic  $^{18}\text{F}$ -FDG PET/CT image findings will ensure staging and restaging accuracy and avoid unnecessary biopsy.

**Key Words:** COVID-19; vaccination; lymphadenopathy

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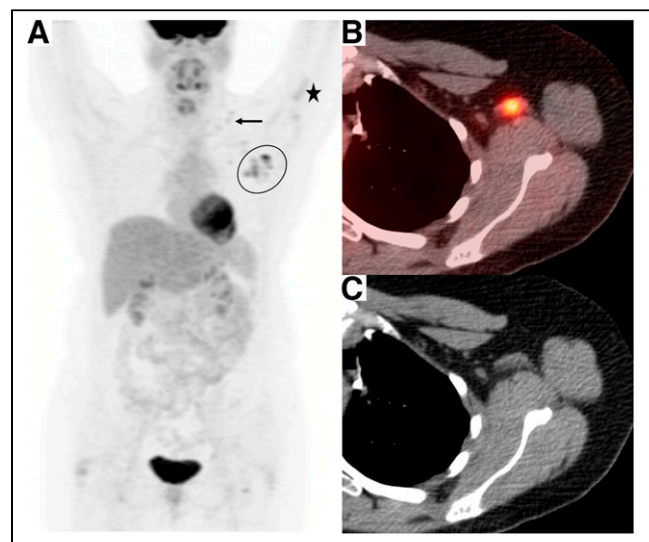
**R**eactive lymphadenopathy is a recognized side effect related to vaccination. With messenger RNA–based coronavirus disease 2019 (COVID-19) vaccines, efficacy depends on the activation of dendritic cells after administration. These activated antigen-presenting cells must then migrate to the draining lymph nodes and present the translated protein to the node-based B and T cells in order to create robust humoral and cell-mediated adaptive immunity (1). As more oncologic patients start to receive COVID-19 vaccines, it is important to recognize the benign  $^{18}\text{F}$ -FDG PET/CT imaging features immediately after vaccination to ensure staging accuracy and prevent unnecessary biopsy.

## CASE REPORT

A 40-y-old woman with a history of metastatic left proximal tibia osteosarcoma underwent surveillant  $^{18}\text{F}$ -FDG PET/CT. There was no radiotracer uptake suggestive of tumor recurrence. However, multiple morphologically benign-appearing hypermetabolic lymph nodes were visualized at the left axillary and supraclavicular regions, as well as focal uptake in the left deltoid muscle (Fig. 1). On further interview, the patient revealed receiving her second dose of the BNT162b2 vaccine (Pfizer/BioNTech) against SARS-CoV-2 the day before the  $^{18}\text{F}$ -FDG PET/CT scan. She also stated that she had experienced pain at the left-upper-arm injection site, intense body aches, headaches, and a slight fever. Combined with inoculation history and characteristic imaging

features, as well as exclusion of tracer injection at ipsilateral arm, a diagnosis of reactive lymphadenopathy secondary to COVID-19 vaccination was achieved.

Reactive lymphadenopathy is one of the well-documented reactions after intramuscular injection of COVID-19 vaccine and is likely secondary to a robust vaccine-elicited immune response (2,3). The efficacy of messenger RNA COVID-19 vaccine depends on encoding dendritic cell migration to draining lymph nodes in order to kickstart the complex humoral and cell-mediated response and, ultimately, to establish immunity (2). There are rich draining lymph nodes at the axillary region that may show an immediate response after vaccination (4,5).  $^{18}\text{F}$ -FDG is a glucose analog and is nonspecifically trapped in metabolically active tumor cells and benign conditions such as infection and inflammation, potentially leading to false-positive interpretations on oncologic  $^{18}\text{F}$ -FDG PET/CT scans (6). Among the most common etiologies of hypermetabolic axillary lymph nodes on  $^{18}\text{F}$ -FDG PET/CT scans are malignancies, reactive changes, and lymphatic drainage of radiotracer extravasation.



**FIGURE 1.** (A) Maximum-intensity-projection image demonstrating cluster of hypermetabolic left axillary lymph nodes (encircled), cluster of hypermetabolic supraclavicular lymph nodes (arrow), and faint intramuscular radiotracer uptake (star). (B and C) Representative left axillary lymph node that appears benign on axial CT image (C) but demonstrates increased uptake ( $\text{SUV}_{\text{max}}, 7.1$ ) on axial  $^{18}\text{F}$ -FDG PET/CT image (B).

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## CONCLUSION

With more oncologic patients receiving messenger RNA COVID-19 vaccines, it is important for nuclear radiologists to recognize the characteristic benign  $^{18}\text{F}$ -FDG uptake after vaccination. A detailed COVID-19 vaccination history, including the inoculation time, which arm was injected, and any side effects, should be acquired before the  $^{18}\text{F}$ -FDG PET/CT scan to ensure the accuracy of staging or restaging and to avoid an unnecessary biopsy.

## DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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